Survey of Beneficial Insects in Undisturbed Cattle Droppings on Oahu, Hawaii

R.L. HARRIS[1], K. ONAGA[2], R.R. BLUME[1], J.P. ROTH[1], and J.W. SUMMERLIN[1]

ABSTRACT

Insects were collected from cattle droppings at 2 locations on Oahu, Hawaii; one on the wet east side (Kualoa) and one on the dry northwest side (Poamoho). From these areas, 7 species of Scarabaeidae were collected. The most numerous species were *Onthophagus gazalla* F., *Onthophagus sagittarius* (L.), and *Aphodius lividus* (Oliver). Four species of Hydrophilidae were collected of which *Cercyon quisquilius* (L.) was the most numerous. Of the predator beetles, 9 species of Staphylinidae [*Oxytelus* sp., *Philonthus* (probably *longicornis* Steph.), *Philonthus rectangulus* Shp., *Philonthus discoideus* Grav., *Philonthus* sp., *Platystethus* sp., *Lithocharis* sp., *Eulissus* sp., and *Xantholininae* gen. sp.] and 2 Histeridae [*Pachylister caffer* (Erich.) and *Hister nomus* Erich.] were collected; all low in numbers except the *Oxytelus* species. Dipterous larvae, in 6 families and other unidentified families, were collected. In general, beetles were more abundant at Poamoho than at Kualoa and dipterous larvae were more abundant at Kualoa.

INTRODUCTION

The horn fly [*Haematobia irritans* (L.)], a native of Europe, is a serious pest of cattle in Hawaii. It invaded North America in 1887 and Hawaii in 1897 (Herms 1950). Since its establishment in Hawaii, numerous natural enemies and competitors have been imported for its control. These include 10 species of parasitic Hymenoptera, 15 species of predators, and 21 species of dung breeding scarabs (Legner 1978). Of these 46 species, only 14 are known to be established in Hawaii.

The horn fly continues to be a serious problem in Hawaii, even with the introduction of these beneficial insects. The purpose of this study was to determine what species are present in cattle droppings under pasture conditions on Oahu in order to estimate their relative abundance.

METHODS AND MATERIALS

The insects were collected from cattle droppings at two locations on Oahu. One located on the Kualoa Ranch (Kualoa) near Waiahole on the east side and one on the University of Hawaii Poamoho experiment station (Poamoho) near Waimea on the northwest side. The rainfall varied from a high of 250 cm/yr at Waiahole to 118 cm/yr at Waimea (Blumenstock and Price 1967).

The dung fauna was sampled by marking 5 cattle droppings at the time of defecation and collecting them 1 or 2 days later. The droppings plus about 7.5 cm of soil beneath it were placed in a plastic bag and stored in a styrafoam ice

[1]VTERL, ARS USDA, College Station, TX 77841.
[2]Department of Entomology, Univ. of Hawaii, Honolulu, Hawaii 96822.

chest used for transporting to the laboratory. The insects in the dropping were collected by breaking the dung into small pieces and removing them with the aid of forceps. The soil samples were placed in Berlese funnels for removal of the insects.

Five samples were taken from each location on 4 dates during 1980. They were collected at Kualoa on February 24, April 1, April 27, and July 20 and at Poamoho on April 2, April 23, May 24, and July 22.

RESULTS AND DISCUSSION

The number of adult dung inhabiting beetles collected is presented in Tables 1 and 2. These included 7 species of Scarabaeidae and 5 species of Hydophilidae. The predominant scarabs were *Onthophagus gazella* F., *Onthophagus sagittarius* F., and *Aphodius lividus* (Oliver) and the predominant Hydrophilidae was *Cercyon quisquilius* (L.). *Onthophagus gazella* was introduced in 1958 for horn fly control, however, *O. sagittarius* was accidentally introduced (Legner 1978). Legner (1978) did not list *A. lividus* was having been introduced into Hawaii, however Toyama and Ikeda (1976) did recover this species on Oahu. The hydrophilid, *Sphaeridium scarabaeoides* L., and scarab, *Onthophagus incensus* Say, were introduced in 1909 and 1923, respectively (Legner 1978). The scarab *Oniticellus cinctus* (F.) was an accidental introduction. Legner (1978), in his review, did not indicate how the other species entered Hawaii.

Although the data are not adequate to compare populations, there appears to be location differences. The number of beetles collected at Poamoho (3221) was much higher than that at Kualoa (619). This could be due to differences in rainfall. The average annual rainfall at Poamoho is lower than that of Kualoa (Blumenstock and Price, 1967). Rainfall could alter the conditions of the droppings and increase the moisture in the soil. These changes could increase mortality of immatures. The populations at Kualoa did increase in July which could possibly be due to drier conditions as June and July are the driest months at this location.

There were 9 species of Staphylinidae and 2 species of Histeridae collected (Table 2). These beetles are known to be predacious on eggs and larvae of the horn fly and other dung-breeding Diptera. The histerid beetles were introduced into Hawaii between 1898 and 1963 for fly control (Legner 1978). Toyama and Ikeda (1976) collected 6 species of Histeridae compared to our 2 species in this study, however their collections were also from accumulated livestock and poultry manure. The predominant species of Staphylinidae was *Oxytelus* sp. whose feeding habits were scarcely known. Koskelu and Hanski (1977) classed *Oxytelinae* as coprophagous, therefore the species of *Oxytelus* collected in this study probably has little effect on horn fly populations. The other known predators (*Philonthus* sp.) occurred in such low numbers that they probably had little effect on fly populations. Again, as with the scarabs and hydrophilids, numbers of beetles were greater at the drier location, Poamoho. Legner (1978) indicated that at least 3 species of Staphylinidae had been introduced into Hawaii. We found only the *Oxytelus* sp., however there is no record of introduction of other species found in this study. A few unidentified *Philonthus* were introduced (Swezey 1911). This could be the source of some of the species recovered. Also some of the species could have been introduced through shipment of cattle.

TABLE 1. Number of adult scarabs and hydrophilids sampled from 5 cattle droppings from February through July 1980, at 2 locations on Oahu, Hawaii.

Species	Date					
	Feb. 2	Apr. 1-2	Apr. 23-27	May 24	July 20-22	TOTAL
			Poamoho			
Scarabaeidae						
Copris incertus	–	2	1	8	0	11
Onthophagus incensus	–	19	92	0	0	111
Onthophagus sagittarius	–	235	297	77	135	744
Onthophagus gazella	–	218	317	44	304	883
Oniticellus cinctus	–	1	1	0	1	3
Aphodius lividus	–	152	121	33	386	692
Ataenius sp.	–	4	1	2	43	50
Hydrophilidae						
Cercyon sp. #1	–	2	0	0	4	6
Cercyon quisquilius	–	47	15	5	56	123
Cryptopleuron sp.	–	0	0	1	0	1
			Kualoa			
Scarabaeidae						
Copris incertus	0	2	1	–	1	4
Onthophagus incensus	0	22	2	–	2	26
Onthophagus sagittarius	2	15	5	–	114	136
Onthophagus gazella	8	30	7	–	115	160
Oniticellus cinctus	0	0	1	–	0	1
Aphodius lividus	9	9	9	–	107	134
Hydrophilidae						
Sphaeridium scarabaeoides	0	1	1	–	0	2
Cercyon quisquilius	2	8	8	–	36	44
Costeum sp.	2	0	0	–	0	2
Cercyon sp. #1	0	0	0	–	3	3

Adult Diptera were not collected, however numerous larvae, identified to family, were collected (Table 3). The most numerous family, as far as numbers, were Sepsidae; however the biomass was much greater for the Muscidae. There was a total of 390 dipterous larvae collected at Poamoho compared to 3,114 at Kualoa. The reduced number of larvae at Poamoho could be due to beetle activity or climate. Previous studies (J. Seabrook personal communication) indicate that the number of horn fly adults emerging from droppings were greater at the drier locations in Hawaii. The discrepancy can only be resolved by conducting a thorough study of insects associated with bovine dung in Hawaii.

The data presented in this paper indicates a somewhat limited beetle fauna in cattle droppings. Many of these beetles have been introduced, but no data are available on how they influence horn fly populations under Hawaiian conditions.

TABLE 2. Number of adult staphylinids and histerids sampled from 5 cattle droppings from February through July 1980, at 2 locations on Oahu, Hawaii.

Species	Date					
	Feb. 24	Apr. 1-2	Apr. 23-27	May 24	July 20-22	TOTAL
			Poamoho			
Staphylinidae						
Platystethus sp.	–	0	0	0	3	3
Oxytelus sp. #1	–	215	120	148	54	537
Philonthus (probably *longicornis*	–	6	4	2	2	14
Philonthus rectangulus	–	0	0	0	3	3
Philonthus discoideus	–	6	0	0	0	6
Philonthus sp.	–	2	0	0	0	2
Eulissus sp.	–	0	0	2	5	7
Lithocharis sp.	–	0	0	3	0	3
Histeridae						
Pachylister caffer	–	7	5	1	4	17
Hister nomus	–	16	2	2	0	20
			Kualoa			
Staphylinidae						
Oxytelus sp. #1	36	16	0	–	31	83
Philonthus (probably *longicornis)*	2	3	0	–	1	6
Philonthus rectangulus	1	0	0	–	0	1
Eulissus sp.	0	0	0	–	1	1
Xantholininae gen. sp.	0	0	1	–	0	1
Histeridae						
Pachylister caffer	0	1	1	–	1	3
Hister nomus	0	2	0	–	0	2

TABLE 3. Number of dipterous larvae collected from 5 cattle droppings from February through July 1980, at 2 locations on Oahu, Hawaii.

Family	Date					
	Feb. 24	Apr. 1-2	Apr. 23-27	May 24	July 20-22	TOTAL
			Poamoho			
Muscidae	–	124	66	3	0	193
Sarcophagidae	–	8	0	3	11	22
Sepsidae	–	165	6	0	3	174
Bradysia	–	0	0	0	1	1
			Kualoa			
Muscidae	124	293	716	–	123	1256
Sarcophagidae	1	16	13	–	29	59
Sepsidae	1039	301	343	–	64	1747
Acalyptratae[1]	10	0	2	–	0	12
Other Family[2]	39					39

[1]Family undetermined.
[2]Includes Drosophilidae, Sphaeroceridae, and Psychodidae.

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